SN 1987A Large Magellanic Cloud

Origins – Strategic Technology

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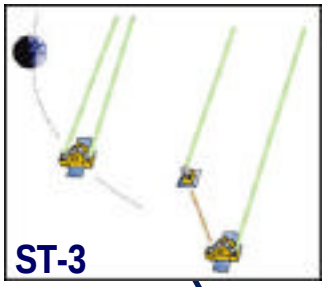
Strategic Technologies Are the Enabling Threads between the Origins Missions

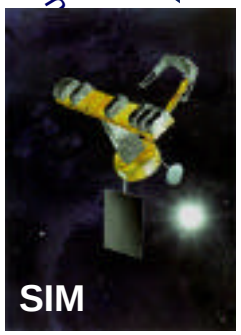
NASA's decadal investment in strategic Origins technologies will approach $1B



Precision Formation Flying

Spaceborne Fringe Acquisition

Long Baseline Starlight Nulling Arrays



- Space Interferometry
- Starlight Nulling

- Active Control
- Precision Deployment

- Cold Optics
- IR Focal Planes
- Passive Cooling

- IR Focal Planes
- Passive Cooling

- Large Cold Optics
- IR Focal Planes
- Large Deployable Optics

Next Generation Missions

- Life Finder
- Planet Imager
- New Concepts

Strategic Technology Discussion Topics

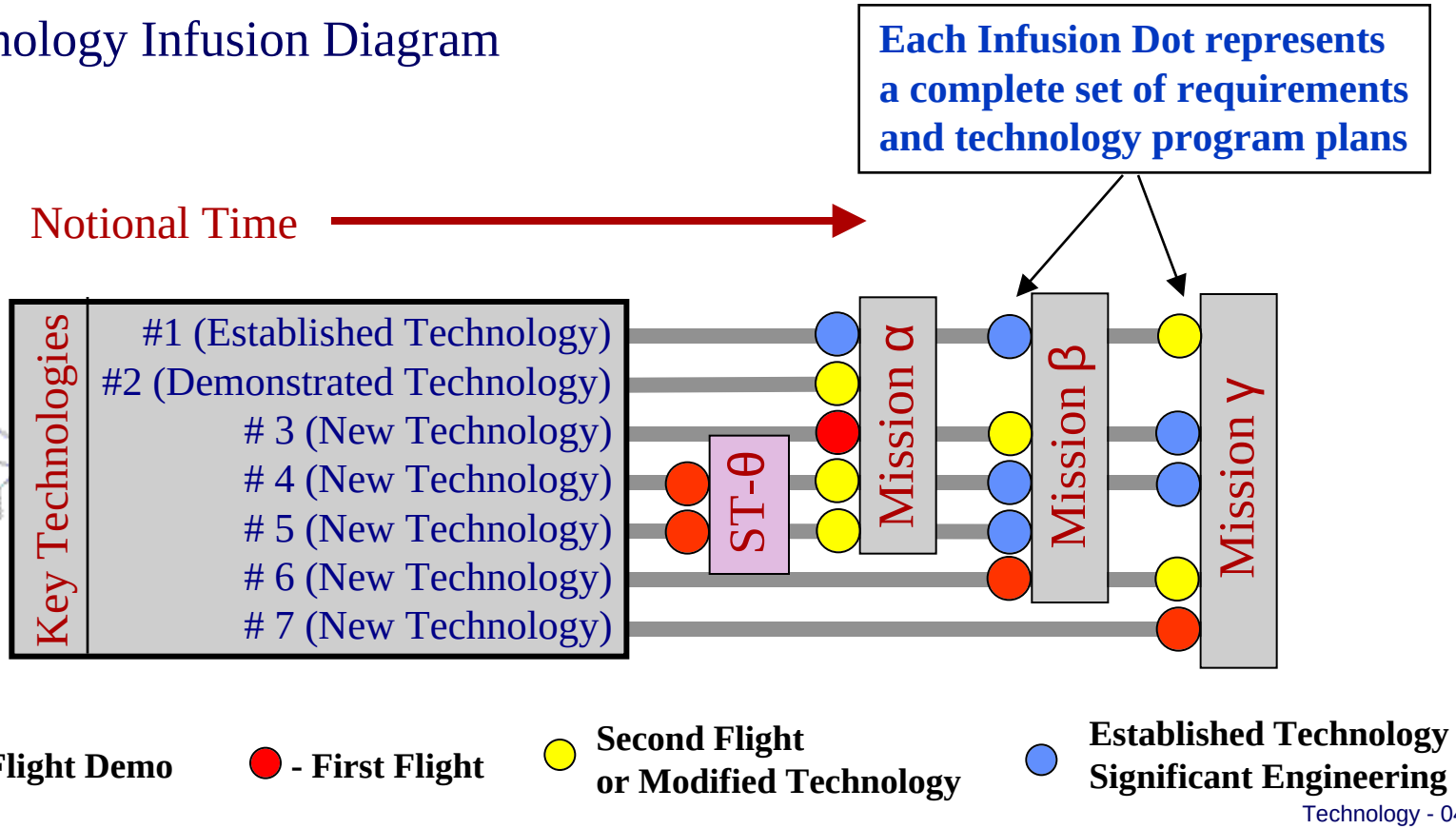
Strategic Technology

ORIGINS

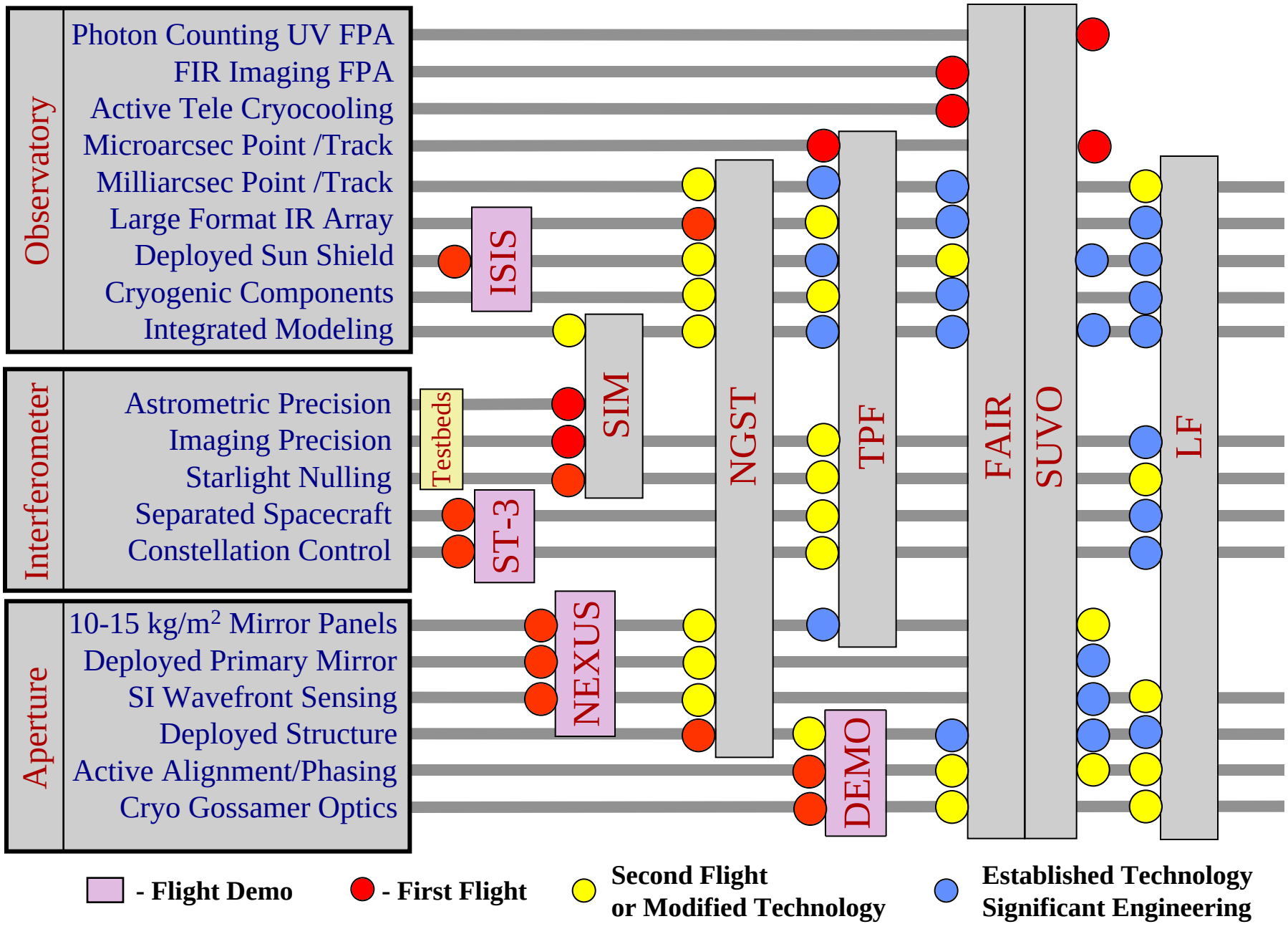
- Technology Infusion
- Large Telescope Systems Initiative
- Partnerships and Cross Theme Integration
- Decadal Resource Summary

Technology Infusion

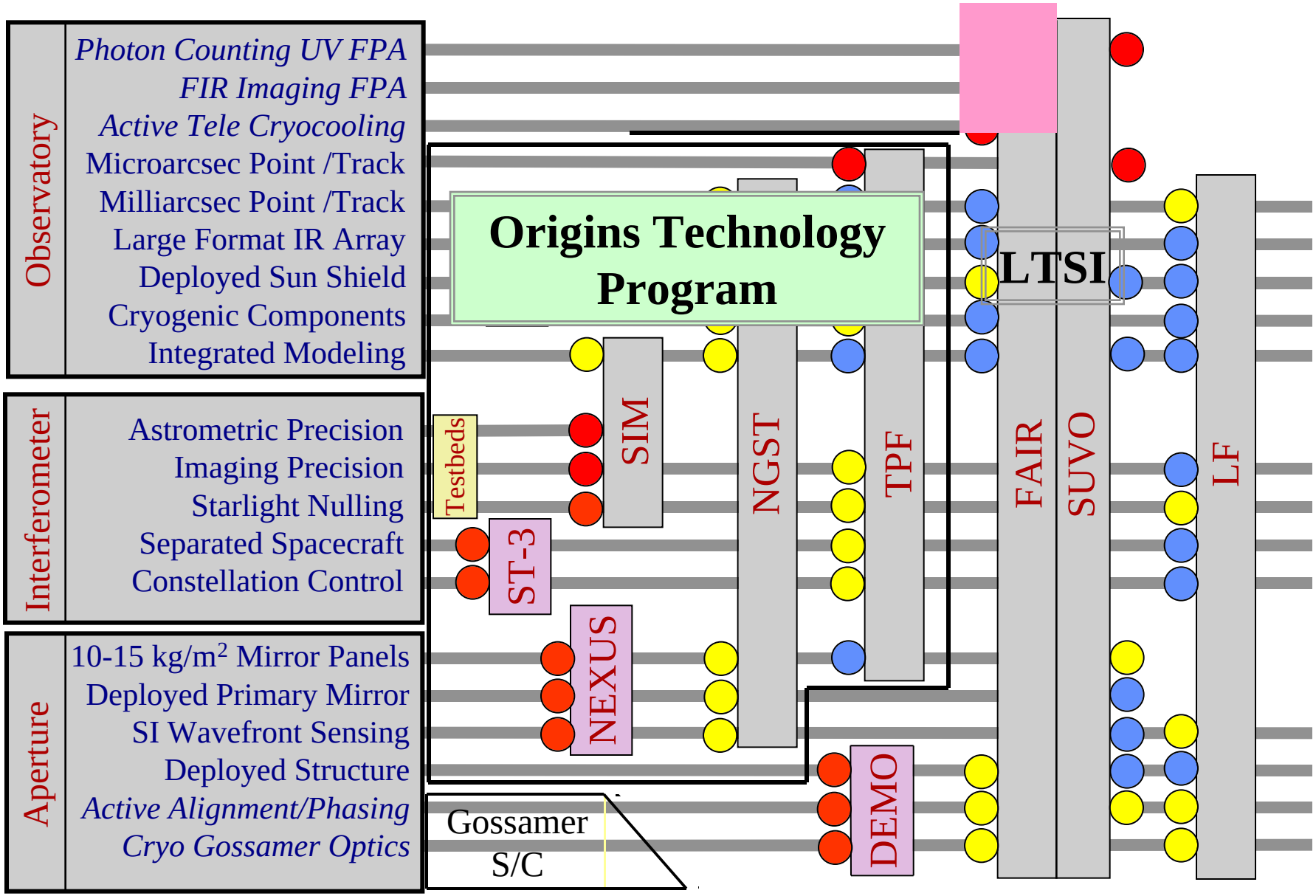
- The Origins missions are technologically rich – Each step forward demands new capabilities – Each step is also critically dependent upon precursor technology successes.
- How do we map, balance and manage the program's overall flow of technology to insure maximum benefit from proven capabilities while still laying the foundation for bold future missions?
- Technology Infusion Diagram



Origins Strategic Technology Infusion Flow



Strategic Technology Development Programs



Large Telescope Systems Initiative – LTSI

- Initial LTSI focus on four critical enabling capabilities for space observatories beyond NGST and TPF
- Additional key system issues will emerge as initial progress matures

Applied Gossamer Mirror Technology

- Key Technology Motivation
  - Affordable Manufacturing and Launch Cost
- Goal Metrics
  - Diameter >25 meters
  - Deployable or Erectable Mirror & Structure
  - Total Mass < 1,000 kg <2 kg/m^2
  - Production Rate > 125 m^2 per year
- Precursor - Gossamer S/C Initiative

Large Telescope Cryocooling

- Key Technology Motivation
  - FIR Science Performance
- Goal Metrics
  - Optics Temperature < 10K
  - No additional stray light background
  - Mass < TBD, Power < TBD
- Precursor - Active Cooler - FIRST
  - Stored Cryogen - SIRTF

Active Wavefront Metrology and Control

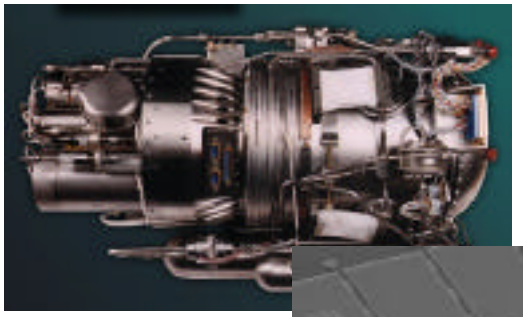
- Key Technology Motivation
  - Adequate Optical Performance
- Goal Metrics
  - Full Time, Full Aperture Correction
  - Diff. Limited at TBD wavelength
  - Mass < TBD, Power < TBD
- Precursor - NGST Wavefront Control

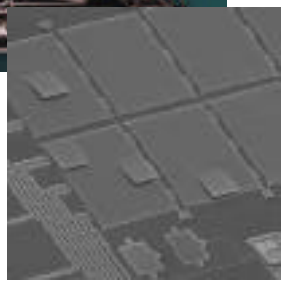
Advanced UV and FIR Detector Arrays

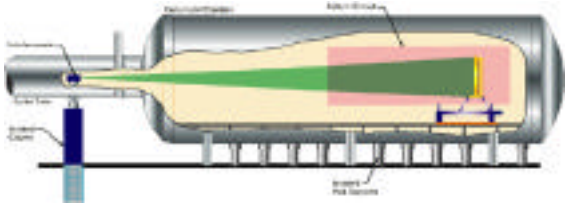
- Key Technology Motivation
  - UV and FIR Science Performance
- Goal Metrics
  - UV QE > .2, FIR Array > 500x500
  - Photon counting noise statistics
  - Ancillary cooler mass < TBD, Power < TBD
- Precursor - CETDP Advanced Sensors
  - NGST Instrument Cryocooler

Cross Theme Technology Integration

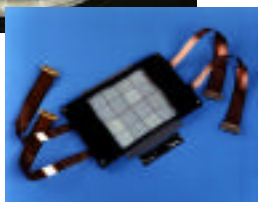
- Shared Requirements with SEU
  - Astronomical Instrument Advances
    - UV and FIR detector improvements
    - Ancillary instrument cryocoolers (<10K)
    - Electro-optic and Cryo-mechanical Devices
  - Large Optical System Technologies and Facilities
  - Spacecraft constellations and constellation flight operations





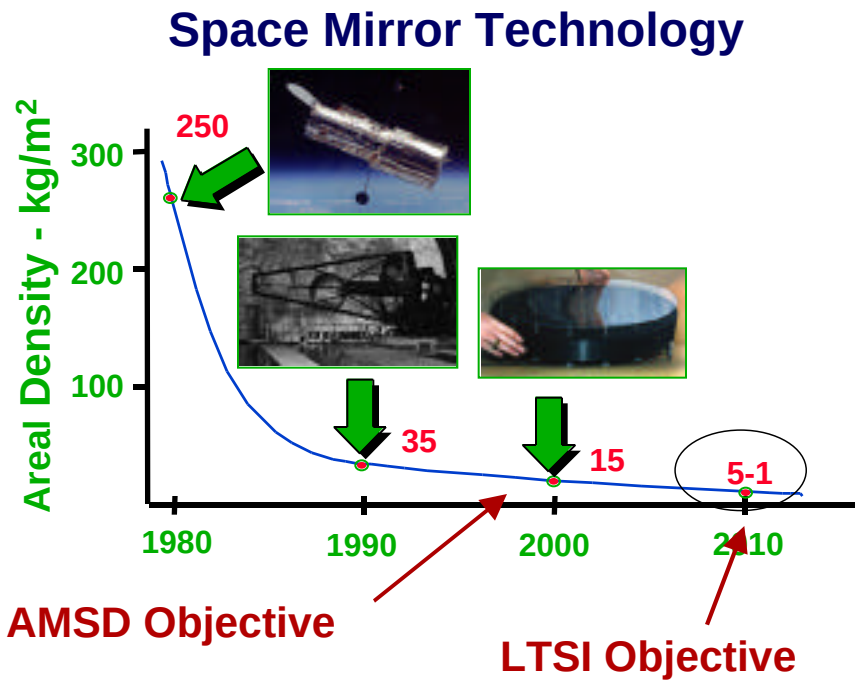


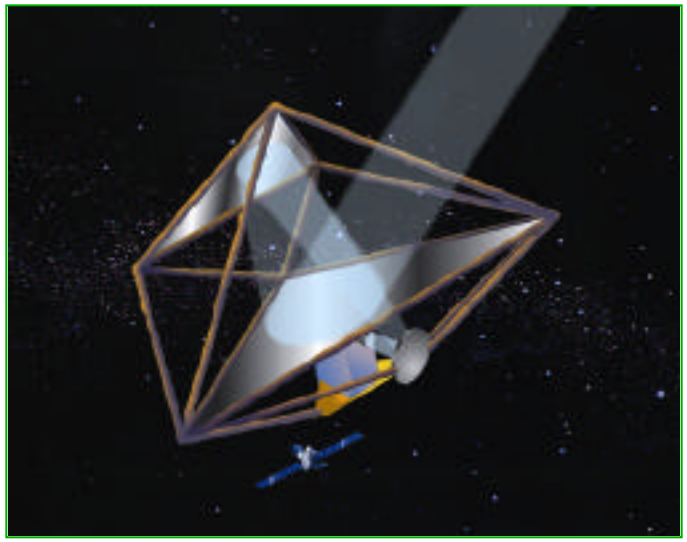
- Benefits from Deep Space Systems Technology Development
  - Avionics, power systems, telecom
  - Additional onboard computational power
  - Planetary surface and subsurface access and mobility for astrobiology



Technology Partnerships

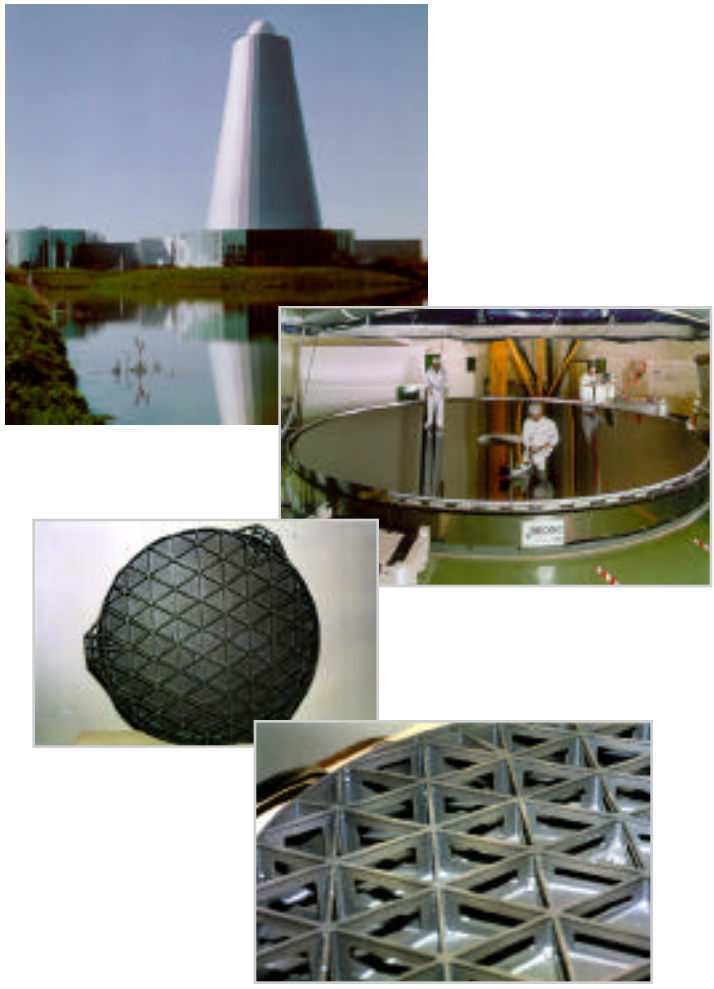
- Adequate Access to DoD Partners
  - All formulation phase origins projects have appropriately cleared staff and partner contacts
- Space Optics Technology - AMSD
  - NASA/Air Force/NRO partnership
  - Common Need and Shared Vision
  - Modest Near-term Cost Impact
  - Institutional Issues Resolved
    - Pooled Resources - $15M Total
    - Single Procurement, Multiple Awards
- Deployable Optical System Flight Demo -Nexus
  - A limited DOD partnership is desirable, but no longer needed to enable flight mission
- Gossamer S/C Initiative
  - DoD is contributing resources to the aperture technology segment
- Advanced Concepts Co-sponsorship
  - DoD has co-sponsored some NIAC advanced large optics concepts





Foreign Space Optics Technology Access

- REOSC, France
  - Large Optics Fabrication Facility
    - 8-meter Mirror Capability
  - Beryllium Capability
  - Rapid Manufacturing Innovations
  - AMSD Partner
- IABG, Germany
  - Silicon Carbide (SiC) Mirror Substrates
  - Invented C/SiC Process
  - Rapid Fabrication of Complex Lightweight
    - Mirror Blanks
  - TRW Majority Ownership
  - AMSD Partner
- Martra Marconi Space, France
  - Developing Large SiC Optics Capabilities
  - New material fabrication process
- Media Lario, Italy
  - Precision Engineering and Metal Mirror
    - Replication Technology
- Russian SiC optics Technology
  - St. Petersburg capabilities no longer viable



Strategic Technology

ORIGINS

Strategic Technology Summary

- Successful Technology Infusion – The Bottom Line
  - We are developing methodologies to track, manage and balance strategic technology infusion across the entire ASO program
- LTSI – A Cornerstone of the Strategic Plan
  - The path to 20-meter class space telescopes requires an observatory systems initiative that is focused on that specific goal.
  - LTSI fills the need. Initially, it will address the most significant issues and harvest high-value products of the Gossamer Spacecraft Initiative
- Partnerships and Cross Theme Integration
  - The Origins technology activity is fully engaged in beneficial partnerships and cross theme integration
- NASA is a Major Player in Space Optics Technology
  - Decadal investment approaches $1B in technology, alone
  - At least 30% of the total US investment over the same time period